UNITED
NATIONS

TD

United Nations Conference
on Trade and Development

Distr.
GENERAL

TD/B/C.1/RM/BAUXITE/2
8 February 1991

Original: ENGLISH

TRADE AND DEVELOPMENT BOARD
Committee on Commodities
Ad hoc Review Meeting on Bauxite
Geneva, 13 May 1991
Item 3 of the provisional agenda

DISCUSSION OF ISSUES FOR IMPROVED PRODUCER-CONSUMER CO-OPERATION

Recent market and industry developments

Report by the UNCTAD secretariat

CONTENTS

Chapter		Paragraphs
	Introduction and summary	1 - 5
I.	Market and industry developments and prospects: summary and outlook	6 - 9
II.	Demand	10 - 27
III.	Supply	28 - 41
	A. Industry structure	28 - 36
	B. Changes in the geographical distribution of production	37 - 41
IV.	International trade	42

ANNEX

CHANGES TO PRODUCTION CAPACITY FOR BAUXITE, ALUMININA AND PRIMARY ALUMINIUM, 1991 TO 1995

Table A.1: Changes to production capacity for bauxite, 1991 to 1995

Table A.2: Changes to production capacity for alumina, 1991 to 1995

Table A.3: Changes to production capacity for primary aluminium, 1990 to 1995

* * *

Note: References to dollars ($) are to United States dollars.

GE.91-50305

READEX FICHE

INTRODUCTION AND SUMMARY

1. This report is intended to provide an overview of changes in the bauxite/alumina/aluminium market, especially during the 1980s as well as an indication of the outlook for the remainder of 1991 and for 1992.

2. Aluminium prices peaked at a historically very high level in June 1988, at the culmination of a period of several years when demand increased more rapidly than supply and inventories were reduced. Since then, prices have declined, although the market remains very closely balanced. It is estimated that demand will increase at a rate of about 2-3 per cent in 1991 and at a slightly higher rate in 1992. Additional capacity entering into operation during the period should suffice to keep the market in balance, although a slight surplus could develop if recessionary tendencies grow stronger. Aluminium prices are, however, not likely to fall below the range of 65 to 75 US cents per pound ($US 1430 to 1650 per ton) for any extended period. As regards alumina, an earlier tight supply situation has eased with increasing production, and prices - in particular on the spot market - are decreasing. Bauxite prices are expected to remain steady.

3. The main factors affecting demand for primary aluminium have been the low worldwide rate of economic growth, the decline in importance of manufacturing in GDP, a slowdown in the process by which aluminium is replacing other materials, reductions in inventories resulting from the introduction of "just-in-time delivery", and an increase in the rate of recycling of aluminium scrap. The slowdown in the process of substituting aluminium for other materials is of considerable importance. The sectors expected to make the major contributions to continued growth in demand are transportation and packaging.

4. On the supply side of the industry, the restructuring process, which was brought about by changes in the price of energy, the aluminium pricing system, government policies and corporate strategies, have resulted in shifts in the geographical distribution of production. The industry has as a consequence been transformed from what could be described as an ordered oligopoly into a more complex structure, which, while it has retained several oligopolistic characteristics, also exhibits many complicated and multifaceted relationships.

5. Developments in the international trade of bauxite, alumina and aluminium reflect the shifts in the distribution of production. This has led, inter alia, to international trade in aluminium increasing more than consumption.

Chapter I

MARKET AND INDUSTRY DEVELOPMENTS AND PROSPECTS: SUMMARY AND OUTLOOK

6. Since the late 1970s, the aluminium industry has gone through three major price cycles, with peaks occurring in 1980, 1983 and 1988, and lows in 1982 and 1985. Since mid-1988, prices have again been moving downwards except for a brief period in August/September 1990, and may reach a low in 1991. During the 1980s, restructuring of the industry continued. It started in the 1970s as a result of cost increases due to rising energy prices, and sluggish growth in demand. Consumption of primary aluminium reached a peak in 1979, which was not again attained until 1986. While the restructuring process in the 1980s touched mainly the aluminium smelter stage of the industry (with large closures of capacity in Japan, the United States and Western Europe and new smelters being added in Australia, Canada and Latin America), there was also significant redistribution of production shares as regards bauxite and alumina, as a result mainly of the large increase in Australia's alumina production.

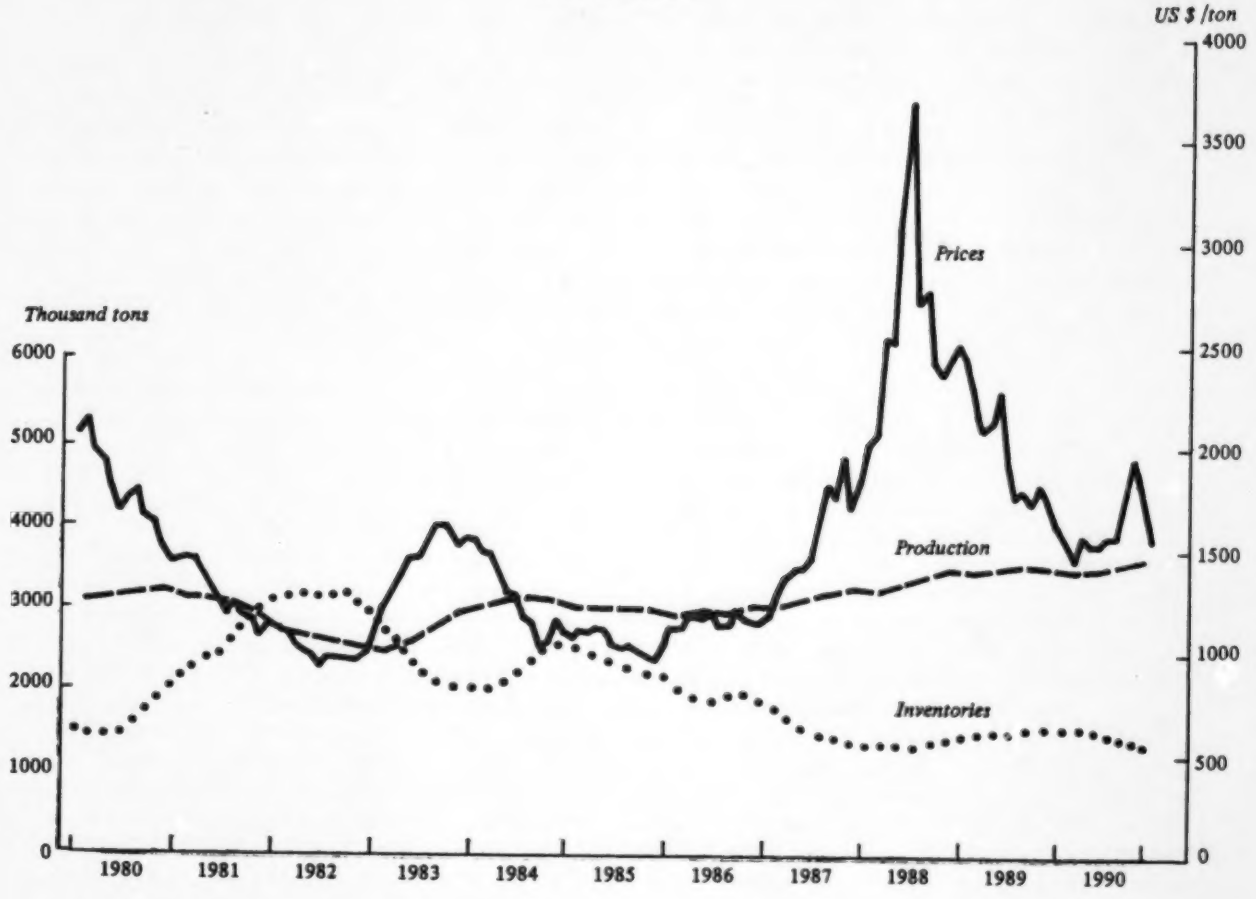
7. The restructuring process did not reach a stage of approximate supply and demand balance until 1987. During the preceeding three years production was constant and consumption increased only slowly. In 1987, the rate of increase in consumption accelerated as a result of generally improved economic conditions and consequently stronger demand for products from aluminium-using industries. Aluminium stocks had been on a downward trend since early 1985 and reached historically low levels by the end of 1987. Demand continued to grow rapidly throughout 1987 and 1988 and prices reached a peak in June 1988 at the same time as stocks were brought down to close to the minimum needed for operations. As production caught up with demand, mainly as a result of higher operating rates in existing smelters worldwide, stock rebuilding began again, and when the precautionary and speculative buying which had pushed prices up during the first half of 1988 ceased, prices fell sharply during the rest of 1988 and 1989, despite stocks remaining at a very low level. Capacity utilization was close to 100 per cent as demand continued to increase through 1989. By early 1990, prices had fallen to a level at which high cost smelters began to encounter cash flow problems. In August and September 1990, aluminium prices again increased as a result of the Gulf crisis, but fell back to low levels at the end of the year (see figure 1). Stocks remained low, although they increased towards the end of the year as a result of increasing production and stagnating or slightly declining demand.

8. The strong growth of demand at the smelter stage, combined with a shortage of alumina refinery capacity, also influenced alumina prices. One and two-year contract prices for alumina more than doubled from 1987 to early 1990, to a level of $350 to $400 per ton. Spot prices, particularly in early 1989, were reported to have reached levels of $700 to $800. Bauxite prices, on the other hand, hardly benefited from the alumina price increases, given the relative abundance of bauxite supplies and the organization of the market where long-term contracts are the dominating feature.

9. As regards prospects for the remainder of 1991 and 1992, supply and demand for aluminium are likely to remain closely balanced. Consumption of aluminium is expected to change at approximately the same rate as industrial production. Given that industrial production in OECD countries can be expected to increase at a rate of about 2 to 3 per cent per year, aluminium consumption is likely to grow at the same rate. The additional capacity

Figure 1

PRICES, PRODUCTION AND INVENTORIES OF ALUMINIUM
1980 TO 1990



Sources: International Primary Aluminium Institute, London; and UNCTAD Monthly Commodity Price Bulletin.

Notes: Prices are monthly averages of London Metal Exchange cash quotations for standard grade (99.5% Al) 1980 to 1988 and high grade (99.7% Al) 1989 to 1990.

Production figures refer to quarterly world production (excluding socialist countries) of primary aluminium.

Inventory figures refer to inventories of primary aluminium 1980 to september 1986 and unwrought aluminium thereafter.

entering into operation during the period should suffice to keep the market in balance, with some risk of a slight surplus developing if recessionary tendencies grow stronger. However, any significant fall in prices below the range of 65 to 75 US cents per pound ($1430 to $1650 per ton) is likely to lead to closures of high-cost smelters and this would push prices back to that range. It should be noted that in a closely balanced supply-demand situation, prices are sensitive and may move significantly in the short term. The sensitivity of the market was clearly demonstrated in August and September 1990, when as a result of the Gulf crisis, aluminium prices on the London Metal Exchange rose from $1700 to $2200 per ton. As for alumina, the tight supply situation has eased with the re-entry into operation of refineries that had previously been closed down and the expansion of production capacity in some others. Consequently, alumina prices, in particular on the spot market, are on the decrease and are unlikely to return to the levels reached in early 1989.

Chapter II

DEMAND

10. Table 1 shows the development of primary aluminium consumption through the 1970s and 1980s. While world aluminium consumption increased at an average annual rate of 4.2 per cent during the 1970s, the corresponding rate in the 1980s was dramatically lower, at only 1.8 per cent. If consumption of secondary aluminium is also taken into account, growth rates were slightly higher, reflecting the increased importance of recycling, but the marked difference between the two decades still remains. There was also a striking difference in the rates of growth between the various regions. The growth rate in developed market-economy countries, particularly the United States, has consistently been below that of the world as a whole, and has resulted in a reduction in the share of world consumption of these countries from three quarters to two thirds between the early 1970s and the late 1980s. Consumption in developing countries, on the other hand, increased at an average annual rate of 9.8 per cent in the 1970s and 6.3 per cent in the 1980s, and these countries increased their share in world consumption from 6 per cent to 14 per cent. Consumption in Eastern Europe and in socialist countries of Asia, after increasing relatively fast in the 1970s, slowed down in the 1980s, and, in the case of Eastern European countries, stopped growing. The level of world consumption in 1990 is generally estimated to be more or less unchanged from 1989.

Table 1

Primary aluminium consumption by regions
(thousand tons and per cent per year)

	Average 1969/71	Average 1979/81	Average annual growth rate 1969/71-1979/81	1989	Average annual growth rate 1979/81-1989
Developed market-economy countries	7454.0	10464.2	3.5	12000.8	1.5
North America	3937.2	4876.9	2.2	4818.7	- 0.1
Europe	2423.7	3570.4	3.9	4492.6	2.6
Japan	897.1	1670.9	6.4	2203.9	3.1
Oceania	136.0	258.5	6.6	354.6	3.6
South Africa	47.4	69.8	3.9	113.0	5.5
Developing countries	593.9	1516.4	9.8	2635.2	6.3
America	214.1	559.1	10.1	748.9	3.3
Africa	26.9	93.6	13.3	132.2	3.9
Asia	274.5	696.2	9.8	1556.0	9.3
Europe	78.4	167.1	7.9	198.0	1.9
Countries of Eastern Europe	1859.4	2719.6	3.9	2613.6	- 0.4
Socialist countries of Asia	228.3	598.7	10.1	770.0	- 2.8
World	10135.7	15298.9	4.2	17944.5	1.8

Source: UNCTAD secretariat.

11. The main reasons identified for the decrease in consumption growth are:

- The worldwide lower rates of economic growth;

- Changes in the relative importance of different elements of GDP, in particular the increased importance of service sectors, or to use a term that has become widely accepted, changes in the product composition of output;

- A slowdown and, in some sectors, a halt to the process by which aluminium had been replacing other materials in different end-uses;

- Reductions in inventories resulting from "just-in-time delivery".

12. Suggestions that metal consumption has become "decoupled" from economic growth[1/] have to be interpreted carefully. What is suggested by recent work in this area is not that metal consumption has become independent of economic growth, but rather that positive income growth does not automatically lead to increased consumption of metals. This situation arises from changes in the intensity of use, which is usually expressed in terms of consumption of a metal per unit of GDP. While intensity of use of aluminium in OECD countries increased at an average annual rate of 4.5 per cent from 1960 to 1973, from 1973 to 1985 the rate of change was -2.1 per cent.[2/] This means that a large part of the decline in consumption growth rates was explained by falling or less rapidly growing intensity of use rather than by the fall in general economic growth rates. Among OECD countries there were, however, large variations. While intensity of use decreased between 1973 and 1985 at an average annual rate of 3.7 per cent in the United States, it fell more slowly, or by 2.7 per cent, in Japan, and by only 0.1 per cent in the European Economic Community.

13. Changes in the intensity of use reflect changes in two of the underlying parameters referred to above - namely, the product composition of output and the rate of substitution - which determine the material composition of products. Changes in the product composition of output, in particular the increased importance of the service sector in GDP in almost all countries, are often assumed to explain changes in materials consumption. The reason for this is partly that services are generally assumed not to use large amounts of material inputs. However, the service sector in most developed market-economy countries increased more rapidly prior to 1973, when growth rates in demand for most minerals and metals started to decline, than thereafter. At the same time, it should be noted that some rapidly growing industry sectors, such as the electronics industry, consume small amounts of material relative to the value of production. Consequently, changes in the product composition of output may account for less of the reduction in the growth of aluminium consumption than is often assumed. Changes in the rate of substitution would then be expected to provide a major part of the explanation for the reduced rate of growth in aluminium consumption. On the basis of studies of the North American market, where, as noted above, the fall in intensity of use has been most significant, it appears that while aluminium penetrated into new markets until the mid 1970s, the rate of growth in aluminium use in most major market segments since then has declined or even turned negative.[3/]

14. Aluminium is used in a multitude of applications in all sectors of the economy. In contrast to the situation for most other metals, demand for

aluminium therefore does not depend on events within one or two narrow end-uses, and it can be assumed to be relatively more resistant to technological change. On the other hand, only in some relatively small sectors is aluminium protected from substitution in the sense that its technical advantages are so large that relative prices play a subordinate role.

15. Major aluminium producers have traditionally emphasized research and development, in particular the development of new products, to stimulate aluminium demand. Annual research and development budgets for some of the large companies are well in excess of $100 million.[4/] The research and development activities of these companies have increasingly focused on the development of new alloys and production processes for specific end-uses, and on broader materials research. This is partly a consequence of user specifications having become more stringent, necessitating the "tailoring" of materials to specific end-uses. Depending on its importance, this tendency carries certain risks for developing-country producers since they often lack the close contacts with final consumers as well as the technological know-how to be competitive in these highly specialized markets. In the following paragraphs, developments in major end-uses are briefly reviewed, with particular emphasis on two sectors where technological development has proceeded rapidly, namely transport equipment and packaging. Table 2 shows the share of different end uses in some major aluminium consuming countries in 1978 and 1988.

16. The transport sector accounts for a large part of aluminium consumption - over 20 per cent in most major industrialized countries. Consumption within this sector has also increased more rapidly than total aluminium consumption. Underlying this trend is both an above-average performance of the transport sector itself compared to other industries and increasing usage of aluminium in transport equipment, particularly automobiles. It should be noted that there are large differences between countries, with the share of the transport sector in aluminium consumption having declined from 1978 to 1988 in the United Kingdom and the United States, while it increased in Germany, France and Japan, reflecting differences in performance of the automobile industries of the respective countries.

17. While in the early 1980s about 4 per cent by weight of the material used in automobile manufacturing was aluminium, the proportion is now approaching 10 per cent in many countries. To a large extent, aluminium has been able to increase its share because of its favourable strength to weight ratio. Thus, efforts to reduce the weight of cars in order to reduce petrol consumption have constituted a positive factor in aluminium consumption.

18. There are several ongoing development projects aiming to increase dramatically the amount of aluminium used in cars, in particular by building the space frame of the car in aluminium instead of steel. While aluminium is more expensive than steel, savings could be made in the production process, either by using extruded aluminium for the space frame rather than stamped sheet,[5/] or by using adhesive bonding techniques, thus reducing the number of welding spots.[6/] Additional advantages accrue from the savings on corrosion protection. In body cover parts, where aluminium has the same advantages over steel as regards weight and resistance to corrosion, competition from plastics is expected to grow in importance. Aluminium has one advantage over plastics, however, since it is easily recyclable, whereas recycling of plastic car body panels is both technically difficult and poses

Table 2

Share of different end-uses in aluminium consumption in 1978 and 1988
(per cent of domestic shipments or consumption)

	Germany		France		United Kingdom		Japan		United States	
	1978	1988	1978	1988	1978	1988a/	1978	1988	1978	1988
Transport	28.3	35.4	34.5	37.3	22.8	13.9	23.1	28.4	23.1	22.7
Mechanical engineering	8.2	9.2	5.4	4.9	5.2	8.3	4.5	4.2	6.0	6.4
Electrical engineering	6.8	4.7	17.0	15.3	11.7	9.6	10.5	7.4	10.4	9.8
Building & construction	19.5	17.1	10.2	13.6	13.0	21.0	34.3	27.9	23.0	19.1
Packaging	10.4	8.8	9.5	8.0	10.8	14.2	6.8	8.0	23.0	29.5
Household articles	8.4b/	5.6b/	6.1	4.8	9.3b/	5.9b/	6.2	1.4c/	7.4	8.6
Misc. metal articles	10.8	10.8	10.2	9.1	20.4	22.6	9.7	n.a.d/	5.6	n.a.d/
Other	7.6	8.4	7.1	7.0	6.8	4.5	4.9	22.7	1.5	3.9e/
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Metal Statistics, Metallgesellschaft, Frankfurt a.M.

a/ Data from 1987
b/ Including office equipment
c/ Data incomplete
d/ Included in "other"
e/ Includes negative statistical adjustment.

environmental hazards. In engines, cast aluminium is already used extensively in Japan, and aluminium matrix composites, which have a considerable weight advantage, may replace steel in the medium term. It has been reported that domestic aluminium demand in the automobile sector in Japan is expected to increase from 950,000 tons in 1989 to 1,870,000 tons in 1995, largely as a result of efforts to conform to United States fuel economy regulations.[7] In summary, the automobile industry is likely to give a significant stimulus to aluminium demand in the medium term.

19. Aircraft account for a relatively small part of aluminium use in the transport sector,[8] but since the sophisticated alloys needed command high prices, this market segment attracts a great deal of attention on the part of major aluminium companies. Titanium has to some extent replaced aluminium in military aircraft, and recently aluminium has also faced strong competition from composite materials containing resins and plastics. Such composite materials have replaced aluminium in many parts of military aircraft since, although their costs are higher, they are lighter and have equal strength characteristics. Because of their high prices, these materials have not yet found wide application in commercial aircraft. As techniques for producing components of resin or plastic-based composites develop, however, they may partly replace aluminium in this market segment as well. To counter this trend, aluminium producers have developed several new aluminium-based materials. These include aluminium-based composites, which have fibers of silicon carbide, alumina or boron carbide in an aluminium matrix, and ARALL laminates, which use layers of fiber preimpregnated resins adhesively bonded between thin sheets of aluminium. Aluminium-lithium alloys containing about 2.5 per cent lithium constitute a less expensive, but still high-cost (three to four times the cost of ordinary aircraft aluminium alloys) alternative. The cost difference results mainly from the high price of lithium together with the need for sophisticated processing, since lithium is a highly reactive metal and since the alloy hardens more rapidly than most aluminium alloys. Aluminium-lithium alloys are also more difficult to recycle, which could prove to be a major disadvantage, since losses in machining can be very high. Superplastic forming of aluminium at high temperatures and low strain rates, which permits complex formed parts to be made from sheet, is also contributing to strengthening the competitiveness of aluminium in aerospace uses. Superplastic forming, which is possible also for aluminium-lithium alloys, is so far being used only for components for military aircraft.

20. Consumption of aluminium in packaging has generally grown at least at the same rate as aluminium consumption in general. There are, however, marked differences among countries, reflecting the degree to which aluminium has been able to penetrate local packaging markets. Among industrialized countries, aluminium use in this sector in 1987 varied from 0.83 kilograms per capita in France to 8.42 kilograms per capita in the United States.[9] The most important difference is for beverage containers, where aluminium cans have achieved a nearly complete dominance in the United States market, but where competition from glass, plastic or tinplate cans remains strong in most other countries. While aluminium cans had over 90 per cent of the market for beverage cans in the United States in 1987, they accounted for about 50 per cent in Western Europe and 20 per cent in Japan.[10]

21. The competitiveness of the aluminium can vis-à-vis the tinplate can rests on low manufacturing costs and a higher degree of recyclability. The cost of the raw material used has been continuously pushed down through the use of

thinner can sheet made possible through innovations in metallurgy (new alloys), metal forming and quality control. The average thickness of the can-body decreased from 0.017 inches in 1970 to 0.014 inches in 1975 and 0.0126 inches in 1987.[11/] Recycling rates for aluminium cans also appear to be on a generally increasing trend. While producers of tinplate cans and of plastic containers are now developing technology and programmes for recycling, it appears unlikely that aluminium will lose this advantage over the next ten years. However, the increase in the rate of recycling of aluminium cans means that less primary aluminium is needed. Aluminium cans are also becoming stronger competitors to tinplate cans in the food packaging sector. While this market segment in most countries is estimated to be smaller than that of beverage cans (about 28 billion units per year in the United States, compared to about 83 billion units for beverages) it is believed that aluminium's share of it could be considerably increased. Problems to be overcome include the need to produce cans in several different sizes, the necessity to use thicker and/or differently alloyed canstock to achieve sufficient rigidity of the can, and a perceived unwillingness of consumers to collect cans for recycling in the same amounts as is being done for beverage cans. The use of aluminium in food packaging has also increased through the use of new technologies for laminating plastic, paper and aluminium foil. These technologies may also make it possible to use aluminium in packaging of food for preparation in microwave ovens. Consequently, the food-packaging sector may provide some opportunity for growth in aluminium consumption.

22. Mechanical engineering accounts for a relatively small share of aluminium consumption, less than 10 per cent in most countries. The share appears to be shrinking in most countries and no new developments leading to significant changes in aluminium use can be identified.

23. The share of aluminium consumption accounted for by the electrical engineering sector has fallen during the 1980s. Two trends appear to account for most of the slowing down of the rate of growth: substitution and downsizing in the electronics industry, and reduced investment in electricity transmission networks, resulting from slower growth in demand for electricity and non-availability of investment funds, in particular in developing countries. The first trend is unlikely to be reversed. Investment in electricity transmission, which can be seen as a relatively "safe" market for aluminium, will depend on the availability of funds for infrastructural investment. The process of modernization in Eastern Europe is of potential importance in this respect. In summary, consumption within this sector may make some positive contribution to demand growth over the next few years.

24. The use of aluminium in building and construction varies greatly from country to country, according to local traditions and tastes. Aluminium is used mainly in doors and windows, but also for building siding, in particular for industrial buildings. It is difficult to discern a clear trend in consumption. While the use of aluminium has increased in France and the United Kingdom, it has decreased in the countries where aluminium was most intensively used, namely Japan and the United States.[12/] The existing large variations in aluminium use in this sector among countries could indicate that there is significant potential for consumption increases in many countries. Whether this potential will be realized, however, depends not only on technical factors and relative price developments vis-à-vis competing materials, but also on promotion efforts by producers.

25. A factor which has assumed increased importance in the 1980s is recycling of aluminium scrap. On a global scale, the use of secondary aluminium increased from 21.5 per cent of total consumption in 1975 to just over 26 per cent of consumption in 1987. The increase in scrap use is partly accounted for by the fall in the rate of increase of aluminium consumption, since the supply of scrap is a function of earlier metal consumption. The growth of aluminium use in beverage cans, which are generally recycled at a rate of between 50 and 90 per cent, has also contributed to the statistically registered increase in scrap use, in particular since the life of a beverage can is short compared to that of most other aluminium-containing products.

26. Finally, high interest rates, computerization of inventory control and the spread of the concept of just-in-time delivery have reduced the size of inventories held by aluminium fabricators. It has been estimated that the impact of just-in-time delivery on the aluminium industry by the end of 1983 was equivalent to a capacity increase of nearly 1.5 million tons per year.[13/] While this estimate may be on the high side, it certainly sheds light on how the aluminium industry has been and is able to function with inventories that earlier would have been considered below the minimum needed to maintain production. The potential for reduction of inventories appears, however, to be exhausted. Consequently, the influence of this factor, which was probably most important during the first half of the 1980s, should be considered a one-time phenomenon.

27. In summary, aluminium consumption appears unlikely to revert to its pattern of the 1960s of growing at twice the rate of industrial production. A more modest growth rate, more or less in line with industrial production, appears more probable. Assuming that industrial production in OECD countries can be expected to grow at an annual rate of 2 to 3 per cent in 1991 and 1992, aluminium demand is likely to increase at the same rate. Forecasts made by the industry in late 1990 indicate a similar rate of growth.[14/]

Chapter III

SUPPLY

A. Industry structure

28. During the 1970s and the 1980s the international bauxite/alumina/aluminium industry went through a complex restructuring process brought on by changes in the price of energy, the aluminium pricing system, government policies and corporate strategies. The restructuring process was influenced and probably hastened by the marked fall in the rate of demand growth already discussed.

29. The two oil price increases of the 1970s reduced drastically the competitiveness of aluminium smelters using electrical energy derived from oil and natural gas. As a result, many of these smelters, particularly in Japan, closed down. Whereas in 1980, oil and natural gas accounted for 17.8 per cent of the power used by primary aluminium smelters, the share fell to 6.9 per cent in 1984 and 4.9 per cent in 1989, with hydro-electricity and coal increasing their shares instead.[15/] Prices of electricity generated from other sources, such as hydro-electricity, also rose during the 1970s as power suppliers adjusted their rates to take into account the increased cost of marginal, thermally generated power. In Western Europe and the United States, in particular, these power rate increases brought on further closures, mainly of old, energy-inefficient smelters. As a result, the industry cost curve, which had been sloping sharply upwards in the 1970s, acquired a flatter shape.

30. Access to low-cost electric power has now become even more of a determining factor for the location of new aluminium smelters than before. Table 3 shows ranges for rates of major power suppliers. At the same time, power suppliers have recognized that, given the large variations in the price of aluminium, high and fixed power rates risk leading to smelter closures at times when aluminium prices are low. Since power suppliers generally have a strong interest in keeping power consumption as stable as possible, variable rate contracts, with the power rate linked to the price of aluminium, have been concluded in several cases. While the available information does not allow an accurate estimate to be made of the proportion of smelting capacity that is working under variable power rate contracts, a minimum figure would be 3.1 million tons per year, or over 20 per cent of world capacity excluding Eastern European countries and socialist countries of Asia.[16/]

31. The rise in energy prices also affected the alumina refining stage of the industry. In particular, it resulted in cost increases at oil-using alumina refineries. Other factors are, however, seen as more important to the restructuring of alumina refining.

32. The introduction of aluminium trading at the London Metal Exchange (LME) in 1978, and at New York's Commodity Exchange (Comex) in 1983, brought into being alternative bases for prices in aluminium sales contracts. Whereas aluminium had previously been traded on the basis of producers' prices, in particular the Alcan price, the LME quotation over the years became the main reference price. Through this development, the major aluminium companies lost their power to set prices and the earlier situation, which had been characterized by a high degree of price stability, was replaced by one more resembling that of other non-ferrous metals, with large price fluctuations both in the very short and medium term. The reduction in the degree of

industry concentration that has taken place in recent decades obviously also contributed to weakening the major companies' control over prices. In a later development, it has become more common for prices in alumina sales contracts to be linked to the aluminium price, normally the LME quotation. Consequently, fluctuations in the aluminium price are more easily transmitted to the alumina price than before. Bauxite prices, however, remain mostly fixed under long-term contracts, although often with price formulas taking into account changes in production costs. There are several reasons for this, some of which include the desire of bauxite producers to maintain a stable income (many bauxite mines belong to government-owned companies), the very small proportion of spot market sales and of sales between unrelated corporations and the optimization of processes in alumina refineries to particular types of bauxite, which effectively ties bauxite producers and consumers to each other.

Table 3

Ranking of major utilities in order of increasing total costs of providing service in 1988
(US mills/kwh, 1 mill = 0.1 US cents)

Low Rates (11-20)	Medium Rates (21-30)	High Rates (31-40)	Very High Rates (41 +)
Edelca (Venezuela)	British Columbia Hydro	Preussen	West Australia
Manitoba Hydro	South Africa	Ohio Power Co.	Texas Utilities
Hydro Quebec	New Zealand	Queensland	CEGG United Kingdom
Mideast Gas Turbine	Bonneville Power Authority	New South Wales	Spain
Iceland	Southern Indiana Gas & Electric	Brazil	Japan
	Potomac Edison	Victoria	
	Alabama	Electricité de France	
		Tennesse Valley Authority	

Source: Table derived from Resource Strategies Inc., Limitations on Expanding World Primary Aluminium Smelter Capacity, Exton, Pennsylvania, August 1989, Chapter 4; quoted in C. Nappi: Public Policy and Competitiveness: The case of the Bauxite-Alumina-Aluminium Industry, Paper presented at the Expert Group Meeting for the Nonferrous Metal Project, June 27-30, 1990, UNIDO, Vienna.

33. During the 1970s, governments in bauxite and alumina-producing developing countries adopted policies aimed at increasing these governments' shares of the income generated by the industry. These policies included the introduction of levies on the production and/or export of bauxite and alumina, raised levels of taxation and increased government ownership. These measures met with strong resistance from major vertically integrated companies in the industry and provided an incentive for the companies to reduce their dependence on the countries in question as suppliers of bauxite and alumina.

34. At the end of the 1970s, the major integrated companies (Alcan, Alcoa, Alusuisse, Kaiser, Pechiney and Reynolds) were faced with a changed economic environment, characterized by a declining rate of growth in demand, the need to close down high cost capacity because of energy price increases, loss of control over the pricing of aluminium ingot, reduced profits from early production stages as a result of government policies and an increasing number of new entrants into the market (facilitated by some of the major companies having adopted sales of technology as an important business activity). The proportion of production capacity owned by these six major companies had declined during the 1970s, from 63 to 43 per cent for bauxite, from 66 to 61 per cent for alumina and from 54 to 52 per cent for primary aluminium. Responding to these changes, the companies adjusted their corporate strategies. In general, they strove to concentrate their activities to the downstream stages of the industry - that is, production of semifabricated and finished products - where, because of larger possibilities of product differentiation, they could exercise greater control over prices and put their comparative advantage as regards product development capability to effective use. At the same time, some of them attempted to diversify horizontally into other materials in order to protect themselves against substitution. As regards the earlier production stages, the companies were prepared to accept declining production shares as the result of more recent entrants - mainly developing-country governments and horizontally diversifying international mining companies - increasing their production. In order to reduce their risk exposure at the early production stages, the major companies spread their investments geographically, generally increasing them in countries considered to offer low political risks, such as Australia. They also relied more heavily on joint ventures involving several companies and, often, host country governments, and began using non-equity financing methods to a greater degree.

35. The new industry structure emerging from the process that took place mainly during the 1980s is one with a lower degree of concentration, with the share of production capacity owned by the six companies mentioned above having declined at the end of 1990 to 35 per cent for bauxite, 53.5 per cent for alumina and 40 per cent for primary aluminium. The degree of vertical integration also decreased, with many new entrants at the smelter stage having no backward links. Wholly or partly government-owned companies, in particular in developing countries, have increased their production shares, as have joint venture companies, in particular at the bauxite and alumina stages. A new factor is the increasing number of aluminium smelters operating under long-term tolling contracts,[17/] a practice which has long been common in other non-ferrous metal industries, but which did not previously exist in the aluminium industry. A trading group, the Marc Rich Organization, has led this movement, concluding contracts with a number of smelters in the United States to toll smelt alumina bought from the Jamaican Government under a long-term contract. The Marc Rich Organization has recently also moved into equity participation in alumina refineries, such as the wholly owned and recently re-opened St. Croix refinery in the United States, Virgin Islands and the partially owned Eurallumina refinery in Italy, and in aluminium smelter projects, for instance in Algeria and the Islamic Republic of Iran.

36. The restructuring process has resulted in the industry being transformed from what could be described as an ordered oligopoly into a more complex structure, which, while it has retained several oligopolistic characteristics, also exhibits many complicated and multifaceted relationships. In the following section, changes in the geographical distribition of production resulting from the restructuring process are briefly reviewed.

B. Changes in the geographical distribution of production

37. As a result of the restructuring process described in the preceding section, major shifts took place in the geographical distribution of bauxite, alumina and aluminium production over the past two decades. Table 4 shows these shifts. As regards bauxite production, among the major changes taking place during the 1980s was the reduction of the share of Caribbean countries. This appears to have been due to a number of factors, including the introduction of levies on bauxite exports by governments in the Caribbean area, the desire on the part of the major companies to diversify their sources of raw materials, and the introduction, for projects in Guinea and Australia, of "take or pay" contracts, which had the effect of keeping mines in those countries going when demand fell in the early 1980s. Consequently, bauxite mines in the Caribbean bore the brunt of the downturn in demand, in particular since demand decreased most in the United States, where three major alumina refineries using bauxite from the Caribbean area were closed down. Finally, bauxite mining in the Dominican Republic and Haïti was discontinued in 1982 because of depletion of reserves (in the Dominican Republic, however, mining began again in 1987). Australia and Guinea emerged as major bauxite producers in the 1970s, basing the expansion of production on high-quality reserves. In Europe, bauxite mining has declined since the 1970s, owing to high production costs (underground mining) and changes in alumina refining processes which reduced the competitiveness of European bauxites.[18/]

38. Production of alumina went through a process similar to that of bauxite, with reductions in the Caribbean area, where the rise in oil prices increased operating costs of refineries significantly, and expanded operations in Australia, where the availability of low-cost bauxite and energy were decisive factors. In Europe, alumina production grew through the establishment in the late 1970s and early 1980s of new alumina refineries in Ireland, Italy and Spain. The main deciding factor in these cases was closeness to the European market. In the United States and Japan, a large portion of alumina refining capacity producing for the domestic markets was closed, reflecting the closure of aluminium smelters in those countries. In the United States, however, part of this capacity has recently come back into production.

39. Primary aluminium production stagnated in developed market-economy countries as a group in the 1980s. This stagnation was the net result of closures of smelters with high energy costs in Western Europe, the United States and Japan, and expansions in countries with access to low-cost electrical energy, such as Australia, Canada and Norway. In developing countries, aluminium production continued the rapid expansion which began in the 1980s. Again, the expansion took place in countries where low-cost sources of electrical energy were available, as in Brazil, Venezuela or the West Asian countries.

40. Table 5 shows expected changes in production capacity for bauxite, alumina and primary aluminium during the years 1991 and 1992 (see also tables A.1 to A.3 in the annex). Seen together with the expected development of demand as described in the previous section, they appear to indicate that an easing of the tight supply/demand balance for alumina and aluminium which has characterized the market since 1987 is likely. Whether this easing of the balance will result in lower prices is less certain. Additions to production capacity for instance may not be completed on schedule. Moreover, a drop in prices below the level of operating costs of marginal smelters, around 65 to

Table 4

Production of bauxite, alumina and primary aluminium by regions
(thousand tons gross weight)

	Bauxite			Alumina			Primary aluminium		
	Average 1969-1971	Average 1979-1981	1989	Average 1969-1971	Average 1979-1981	1989	Average 1969-1971	Average 1979-1981	1989
Developed market-economy countries	17861.8	33549.4	42664.0	13278.8	21395.0	22603.0	7460.2	10623.3	10873.7
North America	2301.9	1874.4	770.0	7172.2	7701.4	5908.0	4517.4	5582.2	5585.0
Europe	5589.9	4940.6	3311.8	2524.0	4560.4	5009.0	2013.7	3524.8	3577.2
Japan	-	-	-	1317.4	1886.4	863.0	726.7	957.5	35.0
Oceania	9970.0	26734.3	38583.0	2265.2	7247.0	10823.0	192.7	472.7	1508.3
South Africa	-	-	-	-	-	-	9.8	86.1	168.2
Developing countries	36269.2	47562.7	53507.0	4239.0	6726.6	10173.0	578.2	1772.3	3556.1
Africa	3345.7	14248.7	19402.0	616.0	683.0	627.0	162.3	354.4	435.4
America	27271.1	26014.1	24627.0	3137.8	4409.0	6686.0	168.7	757.1	1698.0
Asia	3590.4	4167.0	6226.0	361.6	657.6	1620.0	199.6	493.6	1085.7
Europe	2062.0	3133.0	3252.0	123.4	977.0	1240.0	47.6	167.3	337.0
Countries of Eastern Europe	9285.0	9830.0	8447.0	3445.4	4895.4	6343.0	2042.4	2878.4	2863.1
Socialist countries of Asia	500.0	1666.7	3650.0	350.0	966.6	1650.0	180.0	362.7	754.0
World	63915.9	92608.7	108268.0	21313.2	33983.6	40769.0	10260.8	15636.7	18046.9

Source: UNCTAD secretariat.

Table 5

Production capacity for bauxite, alumina and primary aluminium by regions in 1979 and end of 1990, and projected changes until end of 1992
(thousand tons gross weight per year)

	Bauxite			Alumina			Primary aluminium		
	1979	1990	Change to end 1992	1979	1990	Change to end 1992	1979	1990	Change to end 1992
Developed market-economy countries[a/]	36790	44110	- 450	22336	24682	+ 600	11163	11155	+ 597
North America	2150	-		8187	6618		5669	5922	+ 469
Europe[a/]	6140	6110	- 450	4679	5249	+ 300	3591	3503	+ 68
Japan	-	-		2630	915		1400	40	
Oceania	28500	38000		6840	11900	+ 300	427	1515	+ 60
South Africa	-	-		-	-		76	175	
Developing countries	52575	58150	+1300	7609	11140	+ 970	1927	4429	+ 665
Africa	13700	18000	+1880	700	700		355	464	+ 220
America	31230	29710	+1800	4880	7480	+ 970	733	2055	+ 210
Asia	4545	7340	- 500	1029	1780		639	1503	+ 235
Europe	3100	3100		1000	1180		200	407	
Total developed market-economy[a/] and developing countries	89365	102260	+ 850	29945	35822	+1570	13090	15584	+1262

Source: UNCTAD secretariat.

a/ Figures for 1979 include capacity in the German Democratic Republic.

75 US cents per pound ($1430 to $1650 per ton) of aluminium, is likely to result in at least temporary closure of these smelters, which would again bring prices back to a higher level. The situation is further complicated, however, by a number of new factors which were not present, or at least not as important, at earlier downturns of the aluminium price cycle.

These factors include:

- The increased reliance on electricity supply contracts with variable rates linked to the aluminium price, which will automatically reduce the operating costs of smelters with such contracts as aluminium prices fall, making these smelters less likely to reduce production when demand weakens;

- The trend towards linking alumina contract prices to the aluminium price, which also reduces the operating costs of smelters as aluminium prices fall;

- The increased importance of tolling contracts with a time span of three years or more, which may isolate the smelters concerned from demand fluctuations.

41. Taken together, these factors may slow down the speed with which the industry will adjust production to a fall in demand. The scarcity of reliable data makes it extremely difficult, however, to quantify the influence of these factors.

Chapter IV

INTERNATIONAL TRADE

42. Tables 6 and 7 show the development of exports and imports for bauxite, alumina and unwrought aluminium during the 1970s and 1980s. It is seen from the tables that whereas international trade in bauxite increased slowly in the 1970s and then stagnated in 1980s, trade in alumina continued to increase in the latter period, although at a reduced rate, and trade in aluminium actually increased faster in the 1980s than in the 1970s. These developments in international trade reflect the shifts in the distribution of production capacity that took place. Thus, the halt in the expansion of international trade in bauxite was mainly due to the increased local processing of bauxite into alumina in Australia, combined with the downturn in bauxite production in the Caribbean area. As for alumina, two thirds of the net increase in world exports during the 1970s and the 1980s were accounted for by Australia. Finally, the rapid increase in international trade in aluminium reflects the relocation of the smelting stage of the industry from major end-use markets to areas rich in low-cost electrical power. Reductions in tariffs on unwrought aluminium in industrialized countries may have contributed somewhat to making this relocation process possible.

Table 6

Exports of bauxite, alumina and unwrought aluminium by regions
(thousand tons gross weight)

	Bauxite			Alumina			Unwrought aluminium		
	Average 1969-1971	Average 1979-1981	1989	Average 1969-1971	Average 1979-1981	1989	Average 1969-1971	Average 1979-1981	1989
Developed market-economy countries	5040.4	8598.5	5902.0	3736.2	9320.6	12656.4	2079.5	3176.3	5265.9
North America	21.6	30.9	43.7	1079.6	841.4	1458.2	1052.4	1068.0	1813.7
Europe	1313.3	2027.7	657.8	689.0	1405.4	2714.6	952.7	1891.4	2225.4
Japan	0.2	0.3	0.5	163.0	370.8	249.6	10.5	9.3	2.9
Oceania	3705.4	6539.5	5200.0	1804.6	6703.0	8234.0	63.3	189.9	1170.2
South Africa	-	-	-	-	-	-	0.6	15.1	53.1
Developing countries	21379.7	26026.2	27799.5	3497.0	5066.0	5428.0	230.8	700.9	1865.1
Africa	1595.0	11109.5	16168.0	607.4	656.8	626.0	140.8	228.5	304.4
America	15769.4	12787.1	9953.0	2862.4	3805.4	4002.0	57.1	292.0	966.7
Asia	2057.4	1783.6	1078.5	-	97.0	220.0	14.9	127.5	427.0
Europe	1957.9	345.9	600.0	27.2	506.8	580.0	18.0	52.9	167.0
Countries of Eastern Europe	673.1	545.3	338.4	409.0	674.0	680.0	509.2	709.7	859.1
Socialist countries of Asia	22.2	369.6	350.0	6.6	24.2	10.0	-	15.0	30.6
Total	27115.4	35539.5	34389.9	7648.6	15084.6	18774.4	2819.6	4601.9	8020.7

Source: UNCTAD secretariat.

Table 7

Imports of bauxite, alumina and unwrought aluminium by regions
(thousand tons gross weight)

	Bauxite			Alumina			Unwrought aluminium		
	Average 1969-1971	Average 1979-1981	1989	Average 1969-1971	Average 1979-1981	1989	Average 1969-1971	Average 1979-1981	1989
Developed market-economy countries	24261.0	30565.6	26587.9	5988.4	10884.4	12752.8	2172.9	3427.8	6570.9
North America	16007.3	16828.0	14650.2	3165.8	5108.8	6371.4	430.2	579.0	1003.7
Europe	4418.4	8828.9	9634.7	2402.6	4568.6	5480.2	1412.9	1891.8	3178.7
Japan	3816.7	4885.7	2269.5	355.6	717.0	79.0	265.9	929.3	2363.2
Oceania	0.2	0.8	2.0	32.2	314.8	480.2	14.1	9.4	7.8
South Africa	18.3	21.2	30.0	31.4	171.6	340.0	37.6	1.8	0.5
Developing countries	428.4	636.8	3613.3	504.0	2243.8	3174.2	263.2	579.4	1054.7
Africa	0.9	3.1	5.0	298.2	736.4	916.0	9.7	14.5	18.5
America	60.3	161.1	3186.7	127.6	937.0	714.2	110.2	128.0	83 8
Asia	126.9	247.4	271.6	70.0	549.2	1464.0	94.2	386.4	938.6
Europe	240.3	225.2	150.0	8.4	21.2	80.0	49.1	50.5	13.8
Countries of Eastern Europe	2393.9	4271.6	6370.0	977.4	1597.4	894.0	281.4	541.2	627.0
Socialist countries of Asia	-	-	-	-	-	220.0	20.3	109.3	184.5
Total	27083.2	35474.0	36571.2	7469.6	14725.6	17041.0	2737.7	4657.7	8437.1

Source: UNCTAD secretariat.

Notes

1/ See P. F. Drucker, "The Changed World Economy", Foreign Affairs 64, p. 768-791, 1986.

2/ J.E. Tilton, "The New View of Minerals and Economic Growth", Economic Record, Vol.65, No.190, September 1989.

3/ C. Nappi, Metal Demand and the Canadian Metal Industry, Centre for Resource Studies, Kingston, Ontario, 1989.

4/ Alcoa's 1986 research budget was $142 million, and it was expected to double before the end of the 1980s (American Metal Market, New York, 19 May 1986).

5/ This is the approach taken in a project sponsored by Hydro Aluminium (see Metal-working News, New York, 23 November 1987, and American Metal Market, New York, 2 December 1987).

6/ The Aluminium Structured Vehicle (ASV) developed by Alcan uses this approach (see Metal-working News, New York, 1 June 1987).

7/ See Japan Metal Bulletin, Tokyo, 20 September 1990 and American Metal Market, New York, 14 November 1990.

8/ Aerospace's share of aluminium consumption in the transport sector in the United States was 17 per cent in 1989. Since the United States accounts for about 75 per cent of all aluminium used in aerospace applications, the share in other countries is considerably lower (see American Metal Market, New York, 2 April 1990).

9/ UNCTAD, The Aluminium Industry of Latin America and the Caribbean: Technical Options and Opportunities for Growth (UNCTAD/COM.2), March 1990, table 29.

10/ In 1989, aluminium's share of the United States beer can market reached 99.93 per cent, and its share of the soft drinks can market was 94.68 per cent (Metal Bulletin, London, 22 February 1990).

11/ C. Nappo, op. cit.

12/ While aluminium consumption in kilograms per thousand US dollars of construction sector activity increased from 1.17 in 1978 to 1.50 in 1987 in France, it decreased from 5.26 to 4.74 in Japan and from 9.33 to 7.88 in the United States during the same period (see UNCTAD: op. cit., table 28).

13/ S. R. Spector, Presentation at the Metals Week Aluminium Symposium, 19-20 October 1987, Zurich.

14/ See Metal Bulletin Monthly, London, November 1990, and American Metal Market, New York, 13 December 1990.

15/ Figures for 1980 and 1984 from P. D. Stobart, Centenary of the Hall & Héroult Processes, International Primary Aluminium Institute, London 1986. Figure for 1989 from International Primary Aluminium Institute, Electrical Power Utilization 1989, London, 13 July 1990.

16/ Variable power rate contracts are used, for instance, in the United States by the Bonneville Power Administration in the Pacific Northwest (ten smelters with a combined capacity of almost 1.6 million tons per year), by Big Rivers Electric in Kentucky (two smelters with a total capacity of 343 000 tons per year) and by Santee Cooper in South Carolina (one smelter with a capacity of 181 000 tons per year); in the Québec province in Canada (at least two smelters with a combined capacity of 390,000 tons per year at present are reported to have variable rate contracts); in the State of Victoria in Australia (one smelter with a capacity of 330,000 tons per year); in Ghana (one smelter with a capacity of 200 000 tons per year); and in Iceland (one smelter with a capacity of 88,000 tons a year).

17/ The major part of the output - at least five smelters in the United States with a combined capacity of over 800,000 tons per year - is covered by tolling contracts. These smelters generally have high operating costs and would, under other circumstances, probably be considered as part of the "swing" capacity.

18/ European bauxites are mainly of the monohydrate type, which requires higher processing temperatures, and therefore more energy, than the trihydrate bauxites produced in most other regions. In addition, the process used for refining monohydrate bauxite does not yield the "sandy alumina" required by most modern smelters to permit dry scrubbing of fluoride emissions.

ANNEX

Changes to production capacity for bauxite, alumina and primary aluminium, 1991 to 1995

Table A.1: Changes to production capacity for bauxite, 1991 to 1995
(thousand tons gross weight per year)

Location	Owners/partners	Capacity end 1990	Change	Completion date	Comments
Brazil					
Poços de Caldas, Minas Gerais	Alcoa	550	+ 50	1991	Expansion for local refinery at same location
Oriximiná, Pará	Alcoa Mineraçao 60% Alcoa 40% Billiton	-	+2500	1992/93	Under study, may reach 4 million tons per year by 1995
France					
Blanquette, Var	Bauxites et Alumines de Provence Alcan	300	- 300	1993	
La Braque, Var	Pechiney	300	- 300	1991	
Les Canonnettes, Var	Pechiney	150	- 150	1991	
Guyana					
Aroaima	50% Reynolds 50% Government	-	+1500	1991	Production to increase to 2 million tons per year by 1994
Linden	Guymine	1500	+1500	1993	Exhaustion of one open pit, opening of another, mainly non-metallurgical bauxite
India					
Madhya Pradesh	Bharat Aluminium (Government)	500	- 500	1992	Exhaustion of reserves
Panchpatmali	National Aluminium (Government)	2400	+1200	mid-90s	Under study
Jamaica					
Breadnut Valley	Jamalco 51% Government 49% Alcoa	1500	+ 550	1991	
Williamsfield and Schwallenberg West	Jamalcan 93% Alcoa 7% Government	2800	-2800	1992	Exhaustion of reserves
Manchester	Jamalcan 93% Alcan 7% Government	-	+2500	1991	To replace above
Lydford, St. Ann	Jamaica Bauxite Mining (Government)	-	+2500		Re-opening discussed (mine closed in 1984)
Suriname					
Moengo	Alcoa	1440	-1440	early 90s	Exhaustion of reserves
Venezuela					
Los Pijiguaos, Bolivia	Bauxiven (Government)	3000	+3000	mid-90s	

Source: UNCTAD secretariat.

Table A.2: Changes to production capacity for alumina, 1991 to 1995
(thousand tons gross weight per year)

Location	Owners/partners	Capacity end 1990	Change	Completion date	Comments
Australia					
Gove, N. Territory	Nabalco 70% Alusuisse 30% Gove Alumina	1450	+ 150	1992	
Wagerup, W. Australia	Alcoa of Australia 55% Alcoa	850	+ 600	1992/93	
Worsley, W. Australia	Worsley Alumina 50% Reynolds 37.5% Billiton 12.5% Kobe Alumina Associates	1350	+ 150	end 1991	Capacity may be further increased to 2.25 million tons per year
Weipa, Queensland	Comalco	-	+1000	mid-90s	New project at existing mine, feasibility study under way
Brazil					
Barcarena, Pará	Alunorte CRVD	-	+1100	1993/94	No definite decision on start-up taken
Sao Luis, Maranhao	Alumínio de Maranhao (Alumar) 65% Alcoa 35% Billiton	730	+ 70	1992	
Greece					
Gulf of Corinth	Hellenic Alumina (Government)	-	+ 600	1993/94	Collaboration Greek/USSR Governments
Guyana					
Mackenzie, Linden	Guymine (Government)	-	+ 300	1992/93	Re-opening under study
India					
Damanjodi	National Aluminium (Government)	800	+ 200	mid-90s	Under study
Renukoot, Uttar Pradesh	Hindustan Aluminium (Private)	300	+ 200	mid-90s	Government permission sought
Ireland					
Aughinish	65% Alcan 35% Billiton	900	+ 100	1991	
Italy					
Porto Vesme, Sardinia	Eurallumina 52% Aluminio Italia 30% Comalco 18% Clarendon	700	+ 200	1991	

Source: UNCTAD secretariat.

Table A.2: (Cont'd)

Location	Owners/partners	Capacity end 1990	Change	Completion date	Comments
Jamaica					
Clarendon	Jamalco 51% Government 49% Alcoa	800	+ 200	1991	
Essex Valley	Aluminium Partners of Jamaica (Alpart) 65% Kaiser 35% Hydro Aluminium	1250	+ 350	mid-90s	Re-opened in 1989, after being closed in 1985. Further expansion under discussion
Trelawny	Government Alcan	-	+1000	mid-90s	Feasibility study being carried out
Venezuela					
Ciudad Guayana	Interalumina 96.5% Government 3.5% Alusuisse	1300	+ 700	1992	Further expansion possible

Table A.3: Changes to production capacity for primary aluminium, 1990 to 1995
(thousand tons gross weight per year)

Location	Owners/partners	Capacity end 1990	Change	Completion date	Comments
Algeria	Government	-	+ 220	1991	Under construction
Australia					
Portland, Victoria	45% Alcoa of Australia 35% Aluvic (Victoria Government 10% First National Resource Trust 10% China International Trust and Investment Corp.	330	+ 60	1992	Expansion studied, partly contingent on power supply conditions
Newcastle, New South Wales	Tomago Aluminium 35% Pechiney 35% Gove Alumina 15% Australia Mutual Provident Society 12% VAW 3% Hunter Douglas	240	+ 180	1993/95	Feasibility study of expansion is now being carried out
Bunbury, W. Australia	Kemerton Aluminium 49% John Holland Holdings 49% Wardley 2% Pennant Holdings	-	+ 185	1994/95	Feasibility study being carried out
Austria					
Ranshofen-Berndorf	Austria Metall (Government)	80	- 80	1992	Closing may be carried out in two stages
Bahrain	Aluminium Bahrain (Alba) 75% Government 20% Saudi Public Investment Fund 5% Breton Investments	225	+ 235	1992	
Brazil					
Sorocaba, Sao Paulo	Companhia Brasileira de Alumínio	180	+ 30	1991	Further expansion by 40 000 tons per year possible by 1993/94
Sao Luis, Maranhao	Alumínio de Maranhao (Alumar) 65% Alcoa 35% Billiton	350	+ 30	1993	Expansion studied
Aratú, Bahia	Alcan	58	+ 30	1993	Under study

Source: UNCTAD secretariat.

Table A.3: (Cont'd)

Location	Owners/partners	Capacity end 1990	Change	Completion date	Comments
Canada					
Arvida, Québec	Alcan	250	- 20	1991	100 000 tons per year shut down during 1990. Capacity replaced by Laterrière (see below)
Laterrière, Québec	Alcan	150	+ 50	1991	Production started in December 1989, last phase entering production early 1991
Sept Iles, Québec	Alouette 20% Austria Metall 20% Hoogovens 20% Sté Générale de Financement de Québec 20% VAW 13.33% Kobe Steel 6.67% Marubeni Corp.	-	+ 215	1992	May be expanded to 430 000 tons per year by 1995
Deschamault, Québec	Alumax	-	+ 215	1992	
France					
Noguères, Pyrenées Atlantiques	Pechiney	75	- 75	1991	
Riouperoux	Pechiney	12	- 12	1991	
Dunkerque	Pechiney	-	+ 215	1992	Under construction
Iceland					
Straumsvik	Atlantal 40% Alumax 30% Granges 30% Hoogovens	-	+ 200	1994	Under study
India					
Angul, Orissa	National Aluminium (Government)	218	+ 115	mid-90s	Under study
Renukoot, Uttar Pradesh	Hindustan Aluminium (Private)	135	+ 117	1993/94	Government permission sought
Korba, Madhya Pradesh	Bharat Aluminium (Government)	100	+ 50	mid-90s	
Iran (Islamic Rep.)					
Bandar Abbas	65% Government 35% International Development Corp.	-	+ 220	1995	Agreement signed 1990
Malaysia					
Bintalu, Sarawak	Hydro Aluminium State Government Private interests	-	+ 120	mid-90s	Under study

Table A.3: (Cont'd)

Location	Owners/partners	Capacity end 1990	Change	Completion date	Comments
New Zealand					
Tiwai Point	NZ Aluminium Smelters 79.4% Comalco 20.6% Sumitomo	257	+ 130	1992/93	30 000 tons to be added through up-grading of existing plant, 100 000 tons through additional potline, all contingent on power supply conditions
Nigeria					
Ikot Abasi	Reynolds Government Private interests	-	+ 180	1992/93	
Norway					
Ardal	Hydro Aluminium	180	+ 20	1992	
Husnes	Sor Norge Aluminium 50.3% Hydro Alum. 49.7% Alusuisse	68	+ 32	1993/95	
Lista and Mosjoen (2 smelters)	Mosjoen Aluminium 50% Alcoa 50% Elkem	205	+ 163	mid-90s	Expansion possible depending on power supply conditions
Sunndal	Hydro Aluminium	140	+100-200	mid-90s	New plant under study, would partly replace old smelter
Mo i Rana	Hydro Aluminium	-	+ 200		Under study
Qatar					
Umm Said	Doha Aluminium 30% International Engineering Consultants 30% United Aluminium Fabricators 15% Amari 10% China National Metals & Minerals Import & Export Corp. 15% Private interests	-	+ 150	1994/95	
Saudi Arabia					
Yanbu	Alujain Corp of Saudi Arabia 60% Xenel Industries & National Industrialization Co. 8% Alumix 8% British Aerospace 8% China Steel 8% Pechiney	-	+ 214	1995	Expandable to 360 000 tons per year

Table A.3: (Cont'd)

Location	Owners/partners	Capacity end 1990	Change	Completion date	Comments
Trinidad and Tobago	Trinidad and Tobago and Jamaican Governments	-	200	mid-90s	Joint venture based on alumina from Jamaica. Under study
United Arab Emirates					
Umm al Quwein	Umalco 30% Government 30.5% United Aluminium Fabricators 21% International Engineering Consultants 10% China National Metals & Minerals Import & Export Corp. & China Everbright Holdings 8.5% Amari	-	+ 240		Project status uncertain
United States of America					
Bellingham, Washington	Alumax	263	+ 9	1991	
Venezuela					
Puerto Ordaz	Aluminio del Caroni (Alcasa) 84.25% Government 15.75% Reynolds	215	+ 180	1992	
Puerto Ordaz	Industria Venezolana de Aluminio(Venalum) 80% Government 20% Japanese consortium	405	+ 50	1993/95	
Puerto Ordaz	Alusur 40% Sural 40% Alcoa 20% Government	-	+ 115	1993/95	Expandable to 180 000 tons per year
Puerto Ordaz	Alumsa 40% Austria Metall 30% Alcasa 30% Pechiney	-	+ 180	1993/95	Construction not yet started
Puerto Ordaz	Aluyana 49% Government 49% Italimpianti and Techint 2% Private	-	+ 180	1993/95	Expandable to 360 000 tons per year
Puerto Ordaz	Aluguay Government Alumax	-	+ 180	mid-90s	Construction not yet started

Table A.3: (Cont'd)

Location	Owners/partners	Capacity end 1990	Change	Completion date	Comments
Puerto Ordaz	Alisa 57.5% Inversiones Ripesa 25% Government 17.5% Dr. Alberto Vollmer Group	-	+ 246	1993/95	
Puerto Ordaz	Aldanca 36% Clarendon 36% Organizacion Diego Cisneros 18% Government 10% Reynolds	-	+ 190	1993/94	Construction not yet started
Puerto Ordaz	Vexxal de Aluminió ASEA Brown Boveri Government	-	+ 180	mid-90s	Construction not yet started
Puerto Ordaz	Kojovan 45% Republic of Korea interests 35% Japanese interests 20% Government	-	+ 140	mid-90s	Capacity to double later in 1990s
Puerto Ordaz	Unnamed project Reynolds Mitsubishi Organización Diego Cisneros Government International Finance Corporation	-	+ 200	mid-90s	Under study